Center for International Securities and Derivatives Markets

The Benefits of Commodity Investment
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Introduction

Historically, direct commodity investments have been a minor part of investors' asset allocation decision. In contrast, indirect investment (e.g., equity or debt ownership of firms specializing in direct commodity market production) was the principal means of obtaining claims on commodity investment. In recent years, however, investable commodity indices and commodity-linked assets have increased the number of available direct commodity-based investment products. In addition, there is evidence that indirect commodity investment, through debt and equity instruments in commodity-linked firms, does not provide direct exposure to commodity price changes (Schneeweis et al., 1997b). However, there is little information on the expected, as well as the actual risk and return performance, of a wide variety of investable commodity indices or commodity linked product that have been marketed. The purpose of this study is, first, to detail the various theoretical arguments for the risk and return advantages for real commodity investment and, second, to test if currently available investable commodity forms such as the Goldman Sachs Commodity Indexes (GSCI), Standard & Poor's Commodity Indexes (S&PCI), or Dow Jones-AIG Commodity Indexes (DJ-AIG CI) offer means to obtain the prescribed theoretical risk and return processes embedded in commodity investment.

In the following section, the basis for and the structure of alternative indirect (e.g., stock funds) as well as direct passive and active option- and futures-based investable commodity products are reviewed. The expected return and risk structure for various direct 'long-only' futures-based investable commodity indices are analyzed as part of a fully diversified portfolio (stocks, bonds, hedge funds, and real estate). Results indicate that the indices have sources of risk and return (e.g. roll return, real options) that are distinct from traditional assets such as stocks and bonds as well as managed futures or hedge fund benchmark indices and offer investors an important area of diversification (Schneeweis et al., 1997a). Conclusions and suggestions for future studies are discussed in the final section.

Commodity Investment in Asset Management

The increased use of commodity trading vehicles in investment management has led practitioners to create investable commodity indices and products that offer unique performance opportunities for investors in physical commodities. As is true for stock and bond performance, as well as investment in managed futures and hedge fund products, commodity-based products have a variety of uses. Besides being a source of information on cash commodity and futures commodity market trends, they are used as performance benchmarks for evaluation of commodity trading advisors and provide a historical track record useful in developing asset allocation strategies. However, the investor benefits of commodity or commodity-based products lie primarily in their ability to offer risk and return trade-offs that cannot be easily replicated through other investment alternatives. Previous research (Schneeweis et al., 1997b) indicates that direct stock and bond investment offers little evidence of providing returns consistent with direct commodity investment. To the degree that firms hedge a major portion of the commodity risk (Chung, 2000), even commodity-based firms may not be exposed to the risk of commodity price movement. Thus for investors, direct commodity investment may be the principal means by which one can obtain exposure to commodity price movements.

Academic research has examined the economic determinant of returns to commodity investment. For example, Fama and French (1988) and Schneeweis, Spurgin, and Georgiev (2000) identified a strong business cycle component in the variation of spot and futures prices of industrial metals. Fama and French (1987; 1988) perform tests of the theory of storage and present empirical evidence that in periods of increasing volatility and risk, convenience yields increase for a wide variety of metals prices (e.g., aluminum, copper, nickel and lead). The theory of storage (Kaldor, 1939; Working, 1948; 1949; Telser, 1958) splits the difference between the futures price and the spot price into the forgone interest from purchasing and storing the commodity, storage costs and the convenience yield on the inventory. Convenience yield reflects an embedded consumption timing option in holding a storable commodity. Further, the theory predicts an inverse relationship between the level of inventories and convenience yield – at low inventory levels convenience yields are high and vice versa. A related implication is that the term structure of forward price volatility generally declines with time to expiration of the futures contract – the so-called "Samuelson (1965) effect." This is caused by the expectation that, while at shorter horizons mismatched supply and demand forces for the underlying commodity increase the volatility of cash prices, these forces will fall into equilibrium at longer horizons.

Litzenberger and Rabinowitz (1995) observe that oil futures prices are often below spot prices--futures markets are backwarddated. Strong backwardation occurs when futures prices are below current spot prices. In weak backwardation, discounted futures prices are below spot prices. Litzenberger and Rabinowitz explain the phenomenon with the existence of "real options" under uncertainty. They show that production occurs only if discounted futures are below spot prices and strong backwardation emerges if the riskiness of future prices is sufficiently high. A major consequence of a declining term structure of forward prices for investment in commodity futures is the opportunity to capture a positive roll return as investment in expiring contracts is moved to cheaper new outstanding contracts.

The diversification benefits of commodities have been studied in Ankrim and Hensel (1993, Anson (1998), Becker and Finnerty (2000), and Schneeweis and Spurgin (1997b), among others. For instance, Becker and Finnerty find that the inclusion of portfolios of long commodity futures contracts (CRB and GSCI) improves the risk and return performance of stock and bond portfolios for the period of 1970 through 1990. They observe that the improvement is more pronounced for the 1970s than the 1980s due to the high inflation of the 1970s with commodities acting as an inflation hedge. Futures prices were also found to have little value in predicting inflation.

The principal argument for investing in commodities is that investing in assets that rise in price with inflation provides a natural hedge against losses in equity and debt holdings that typically lose value during periods of unexpected inflation (see Bodie, 1983; Greer, 1978; Halpern and Warsager, 1998; Becker and Finnerty, 2000). While previous studies have concentrated on measuring commodity returns during high and low inflation periods, the real benefits of commodity investment may lie in periods of unexpected rises in inflation. Anticipated inflation, which results in high bond yields and high equity earnings growth, may result in positive real returns for stocks and bonds. It is the unexpected inflation that should cause concern to every serious investor. The importance of being exposed directly to commodity price movements is due to the possibility of obtaining natural sources of commodity return and inflation protection. In periods of unexpected inflation, market conditions may often lead to increasing commodity prices and weakness in stocks and bonds.

Commodity Indices

One of the most attractive aspects of commodity investment today is that there are now a number of passive indicies that are fully investable. In addition to providing a simple method to access these returns, commodity indicies have a number of other uses. Commodity indicies are a source of information on cash commodity and futures commodity market trends, are used as performance benchmarks for evaluation of commodity trading advisors, and provide a historical track record useful in developing asset allocation strategies.

Commodity indices are generally based on the returns of futures contracts and/or cash markets. Included in this group are the Dow Jones-AIG, Standard and Poor's, and Goldman Sachs. These indices provide returns comparable to passive long positions in listed futures contracts. Commodity indices attempt to replicate the return available to holding long positions and short in agricultural, metal, energy, or livestock investment. Since the cost-of-carry model insures that the return on a fully margined position in a futures contract should mimic the return on an underlying spot deliverable, futures contract returns are often used as a surrogate for cash market performance. Futures-contract-based commodity indices have three separate sources of return: price, roll, and collateral return. Price return derives from changes in commodity futures prices. Roll return arises from rolling long futures positions forward through time and may capture a liquidity premium through an increased convenience yield in periods of high volatility of the underlying due to demand and supply shocks. Collateral return assumes the full value of the underlying futures contracts are invested at a risk-free interest rate. This is equivalent to assuming an investor posts 100% margin with Treasury bills.

Data, Methodology, and Empirical Results

The three primary commodity indices used in this analysis are as follows:

GSCI: The Goldman Sachs Commodity Index (GSCI) is an arithmetic measure of the performance of actively traded, dollar-denominated nearby commodity futures contracts. The weights assigned to individual commodities are based on a five-year moving average of world production. Weights are determined each July and are made effective the following January. All contracts are rolled on the fifth business day of the month prior to the expiration month of the contract. Subindices are calculated for agricultural, energy, industrial, livestock, and precious metals contracts. Two versions of the indices are available: a total return version, which assumes that capital sufficient to purchase the basket of commodities is invested at the risk-free rate, and a spot version, which only tracks movements in the futures prices. The GSCI was officially launched in 1992.

Dow Jones AIG: The Dow Jones-AIG Commodity Index (DJ-AIG CI) is an arithmetically calculated price index composed of futures contracts on 20 physical commodities. The major commodity sectors present in the index are: Energy (including petroleum and natural gas), Petroleum (including crude oil, heating oil and unleaded gasoline), Precious Metals, Industrial Metals, Grains, Livestock and Softs. With the exception of aluminum, nickel and zinc (industrial

metals), which trade on the London Metal Exchange (LME), all other commodities that form DJ-AIG commodity index are traded on U.S. exchanges.

To determine the relative quantities of included commodities, the DJ-AIGCI relies primarily on liquidity data, along with dollar-adjusted production data. It considers the relative amount of trading activity associated with a particular commodity to determine its weight in the index.

In addition, to insure diversified commodity exposure, the DJ-AIGCI relies on several diversification rules. Among these rules are the following:

- No related group of commodities (e.g., energy, precious metals, livestock and grains) may constitute more than 33% of the index.
- No single commodity may constitute less than 2% of the index.

The DJ-AIGCI is re-weighted and re-balanced every January. Re-balancing and re-weighting is designed to reduce the exposure of the index to commodities that have appreciated in value and to increase the index's exposure to commodities that have underperformed. During the course of the year, commodity weights are free to increase or decrease as their values increase or decrease, subject to the two limits imposed above. Therefore, this index is a momentum-type index.

S&P Commodity Index: The S&P Commodity Index (S&PCI) is a geometrically calculated price index comprising futures contracts on 17 consumable commodities within 6 sectors. Gold is excluded. S&PCI index portfolio is effectively rebalanced real-time, maintaining constant dollar exposure across underlying commodities. Index weights for each commodity are determined using the dollar value of commercial open interest in futures markets. Commodity weights are adjusted to reflect double-counting. Upstream commodities (e.g., crude oil) are adjusted downward to account for their presence in related downstream commodities (e.g., heating oil and unleaded gas).

Methodology and Data

Monthly returns are derived for a series of stock, bond, commodity, and hedge fund indices for the time period from January 1990 through December 2003. Data was obtained for each of the indices and relevant subindices (GSCI, S&PCI, DJ-AIG CI), as well as the Standard and Poor's 500 and MSCI World Stock Indices, the Lehman Brothers U.S. Government/Corporate and World Bond Indices, the Hedge Funds Composite Index[1], three-month Treasury bill yields, and the U.S. Consumer Price Index. Stock, bond, commodity, currency and inflation indices are obtained from DataStream and Ibbotson Associates.

[1] The Hedge Funds Composite Index is created as follows: between January 1990 and December 1993 it is an equally weighted portfolio of EACM 100 and HFR, whereas from January 1994 until present it is an equally weighted portfolio of EACM 100, HFR, and CSFB.

Empirical Results

In Exhibits 1 and 2, the average monthly returns and standard deviations of monthly returns, Sharpe ratios, minimum monthly returns, and correlations to the GSCI Index, S&PCI Index, and DJ-AIG CI Index for the sample of stock, bond, hedge fund and commodity indices over the January 1990 through December 2003 period are presented, both as stand-alone investments as well as in various portfolio groupings.

Exhibit 1

Commodity Index Performance 1990-2003

	GCSI	S&PCI	DJ-AIG CI	HF Composite Index	S&P 500	Lehman Gov./Corp Bond	MSCI World	Lehman Global Bond
Annualized Return	6.39%	4.52%	6.70%	13.87%	10.94%	8.03%	6.04%	8.09%
Annualized StDev	19.08%	12.74%	11.81%	5.82%	15.05%	4.45%	14.98%	5.22%
Sharpe Ratio	0.10	0.00	0.21	1.61	0.43	0.80	0.10	0.69
Minimum Monthly Return	-14.41%	-8.97%	-7.54%	-6.92%	-14.46%	-4.19%	-13.35%	-2.97%
Correlation with GSCI				0.11	-0.07	0.04	-0.05	0.09
Correlation with S&PCI				0.15	0.05	0.01	0.06	0.08
Correlation with DJ-AIG CI				0.20	0.09	0.02	0.17	0.13

The annualized return, standard deviation, and Sharpe ratio for the GSCI composite index are 6.4 percent, 19.1 percent, and 0.10, respectively (see Exhibit 1). Results are not much different for the S&PCI composite index or DJ-AIG CI composite index. Thus, both in absolute terms and on a risk-adjusted basis, commodities have underperformed US and world bonds and equities. Nonetheless, commodities may produce investment benefits when considered as an addition to a diversified portfolio. The decision to add an investment product to an existing portfolio depends on the relative means and variances of the investment vehicle and the existing portfolio as well as the correlation between the investment vehicle and the portfolio. The low or negative correlations of GSCI returns with returns to the S&P 500 (-0.07), Lehman Gov./Corp. Bond (0.04), and the HF Composite Index (0.11) suggest such potential benefits. Similarly, when considered as a global investment, the GSCI exhibits low or negative correlations with the MSCI World Index (-0.05) and the Lehman Global Bond Index (0.09). Comparable results hold for the S&PCI and DJ-AIG CI indicies (see Exhibit 1).

The above relationships are reflected in the performance of investment portfolios including the GSCI, S&PCI, or DJ-AIG CI Index (see Exhibit 2). When added to a domestic portfolio of stocks and bonds, the GSCI helps reduce the standard deviation of the portfolio from 8.1 percent to 7.4 percent. Additionally, risk-adjusted performance (Sharpe ratio) remains almost unchanged; it is 0.65 for the domestic stock/bond portfolio, and goes slightly up (to 0.68) when the portfolio includes GSCI index too. Similarly, when added to a global stock/bond portfolio, the GSCI

Exhibit 2

Performance of Portfolios Including Commodity Indexes (1990-2003)

Commodity Index: GSCI

	Portfolio I S&P 500 & Lehman Bond	Portfolio II S&P 500, Lehman Bond & GSCI	Portfolio III S&P 500, Lehman Bond, GSCI, & HF Composite Index	Portfolio IV MSCI World & Lehman Global	Portfolio V MSCI World, Lehman Globa & GSCI	Portfolio VI MSCI World, Lehman Global, GSCI, & HF Composite Index
Annualized Return	9.79%	9.48%	10.07%	7.31%	7.49%	8.08%
Annualized StDev	8.14%	7.37%	7.05%	8.42%	7.69%	7.29%
Sharpe Ratio	0.65	0.68	0.79	0.33	0.39	0.49
Minimum Monthly Return	-6.25%	-6.18%	-6.28%	-5.63%	-5.68%	-5.78%
Correlation with GSCI	-0.05	0.47	0.23	-0.02	0.48	0.26

Commodity Index: S&PCI

	Portfolio I S&P 500 & Lehman Bond	Portfolio II S&P 500, Lehman Bond & S&PCI	Portfolio III S&P 500, Lehman Bond, S&PCI, & HF Composite Index	Portfolio IV MSCI World & Lehman Global	Portfolio V MSCI World, Lehman Globa & S&PCI	Portfolio VI MSCI World, Lehman Global, S&PCI, & HF Composite Index
Annualized Return	9.79%	8.90%	9.77%	7.31%	6.92%	7.79%
Annualized StDev	8.14%	7.10%	7.05%	8.42%	7.39%	7.27%
Sharpe Ratio	0.65	0.62	0.75	0.33	0.33	0.45
Minimum Monthly Return	-6.25%	-6.28%	-6.33%	-5.63%	-5.78%	-5.83%
Correlation with S&PCI	0.05	0.40	0.24	0.08	0.42	0.26

Commodity Index: DJ-AIG CI

	Portfolio I S&P 500 & Lehman Bond	Portfolio II S&P 500, Lehman Bond & DJ-AIG CI	Portfolio III S&P 500, Lehman Bond, DJ-AIG CI, & HF Composite Index	Portfolio IV MSCI World & Lehman Global	Portfolio V MSCI World, Lehman Globa & DJ-AIG CI	Portfolio VI MSCI World, Lehman Global, DJ-AIG CI, & HF Composite Index
Annualized Return	9.79%	9.77%	10.23%	7.31%	7.65%	8.37%
Annualized StDev	8.14%	6.93%	6.88%	8.42%	7.08%	6.93%
Sharpe Ratio	0.65	0.76	0.83	0.33	0.45	0.56
Minimum Monthly Return	-6.25%	-6.27%	-6.33%	-5.63%	-5.77%	-5.83%
Correlation with DJ-AIG CI	0.09	0.43	0.27	0.19	0.50	0.36

Note:

Portfolio I: 50% S&P 500 and 50% Lehman Gov./Corp. Bond

Portfolio II: 40% S&P 500, 40% Lehman Gov./Corp. Bond, and 20% Commodity Index

Portfolio III: 40% S&P 500, 40% Lehman Gov./Corp. Bond, 10% Commodity Index, and 10% HF Composite Index

Portfolio IV: 50% MSCI World and 50% Lehman Global Bond

Portfolio V: 40% MSCI World, 40% Lehman Global Bond, and 20% Commodity Index

Portfolio VI: 40% MSCI World, 40% Lehman Global Bond, 10% Commodity Index, and 10% HF Composite Index

reduces volatility from 8.4 percent to 7.7 percent and increases the Sharpe ratio from 0.33 to 0.39. Similar results hold for portfolios that include S&PCI Index. The impact of including DJ-AIG Commodity Index in a stock/bond portfolio is more evident. At the domestic level, DJ-AIG CI helps reduce the standard deviation of the portfolio from 8.1 percent to 6.9 percent at the expense of increasing the Sharp ratio by about 0.11. At the global level, the standard deviation adjusts from 8.4 percent to 7.1 percent when DJ-AIG CI is added to the stock/bond portfolio. In all cases, adding more assets, such as hedge funds, to the portfolio results in improved performance.

Exhibit 3 shows the performance statistics for the GSCI and DJ-AIG CI component sub indicies. Even though the performance is unimpressive on its own (barring the GSCI Energy and DJ-AIG CI sub indicies), the low or negative correlations with stock, bond, hedge fund, and real estate indices shown in Exhibit 4 again suggest that investors who wish to target particular commodity sectors may still benefit from the addition of that sector to a diversified portfolio of assets.

Exhibit 3

Performance of GSCI Subindexes (1990 - 2003)

	GSCI Agricultural	GSCI Energy	GSCI Industrial Metals	GSCI Livestock	GSCI Non-Energy	GSCI Precious Metals
Annualized Return	-1.09%	8.69%	3.99%	2.17%	1.24%	1.18%
Annualized StDev	13.59%	32.54%	16.82%	13.81%	8.97%	12.39%
Sharpe Ratio	-0.41	0.13	-0.03	-0.17	-0.36	-0.27
Minimum Monthly Return	-9.64%	-22.14%	-12.89%	-15.76%	-6.27%	-8.58%

Performance of DJ-AIG CI Subindexes (1990 - 2003)

	DJ-AIG Energy	DJ-AIG Petroleum	DJ-AIG Livestock	DJ-AIG Grains	DJ-AIG Industrial Metals	DJ-AIG Precious Metals	DJ-AIG Softs
Annualized Return	12.06%	11.31%	0.50%	0.46%	2.87%	1.77%	1.66%
Annualized StDev	29.09%	29.02%	14.04%	16.98%	17.04%	13.37%	17.56%
Sharpe Ratio	0.26	0.23	-0.28	-0.24	-0.09	-0.20	-0.16
Minimum Monthly Return	-21.75%	-22.50%	-12.57%	-12.08%	-11.59%	-9.02%	-12.00%

Commodities as an Inflation Hedge

A significant part of the benefit of direct commodity investment is said to derive from unique fluctuations in commodity values as a function of shifting economic forces. One such aspect of the return process of commodities is that commodity cash prices benefit from periods of unexpected inflation, whereas stocks and bonds suffer. As a result, commodities should provide a positive return while other asset classes decrease in value. This premise is tested by calculating the correlation of spot commodity index returns (as well as stock, bond, hedge fund, and real estate returns) with a proxy for unexpected inflation. The proxy used is the monthly change in the rate of inflation.

Exhibit 4

Factor Correlations (1990 - 2003)

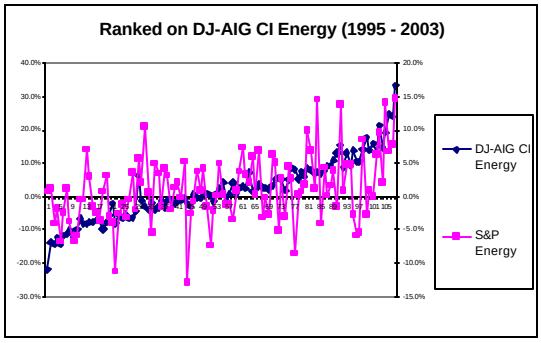
	S&P 500	Lehman Bond	Change in Credit Spread (Baa-Aaa)	Change in VIX	Change in Term Spread	Change in Bond Vol	Change in Stk Vol	Unexpexcted Inflation
GSCI	-0.07	0.04	-0.08	0.03	-0.02	-0.03	-0.13	0.40
GSCI Agricultural	0.18	-0.07	0.01	-0.22	-0.02	0.01	-0.02	-0.39
GSCI Energy	-0.10	0.04	-0.07	0.08	-0.01	-0.02	-0.09	0.43
GSCI Industrial Metals	0.21	-0.17	-0.23	-0.09	0.12	0.08	-0.12	0.18
GSCI Livestock	0.01	0.05	0.00	-0.05	-0.01	-0.03	-0.02	-0.09
GSCI Non-Energy	0.20	-0.06	-0.07	-0.23	0.03	-0.01	-0.09	-0.23
GSCI Precious Metals	-0.09	-0.01	0.08	0.03	0.07	-0.03	-0.09	0.19
DJ-AIG CI	0.09	0.02	-0.13	-0.13	-0.06	-0.02	-0.17	0.22
DJ-AIG Energy	-0.02	0.11	-0.13	-0.02	-0.09	0.00	-0.13	0.34
DJ-AIG Petroleum	-0.01	0.02	-0.17	-0.03	-0.03	0.02	-0.14	0.38
DJ-AIG Livestock	0.00	0.07	0.00	-0.03	-0.02	-0.01	0.03	-0.03
DJ-AIG Grains	0.18	0.01	0.06	-0.20	-0.08	-0.03	-0.01	-0.44
DJ-AIG Ind Metals	0.26	-0.20	-0.18	-0.18	0.09	0.06	-0.15	0.16
DJ-AIG Prec Metals	-0.05	-0.05	0.08	-0.02	0.11	-0.05	-0.09	0.14
DJ-AIG Softs	0.12	-0.17	-0.04	-0.15	0.10	0.02	-0.03	-0.03
S&P 500	1.00	0.14	-0.13	-0.66	-0.05	0.00	-0.29	-0.31
Lehman Gov./Corp. Bond	0.14	1.00	-0.02	0.03	-0.68	-0.11	-0.04	-0.15
HF Composite Index	0.59	0.17	-0.24	-0.40	-0.06	-0.17	-0.36	0.15

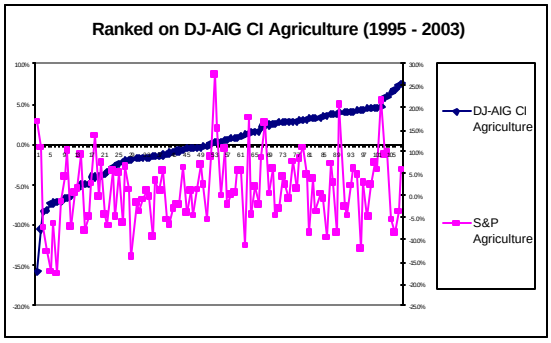
Note: Monthly changes in inflation beyond one standard deviation of the average are used to proxy for unexpected inflation

Direct and Indirect Commodity Investment

It is well known that many commodity-based firms hedge their exposure to commodity price fluctuations. As a result, investment in commodity-linked equities does not replicate the unique price-return behavior of direct commodity investment. This issue is explored here by studying the relationship between the return properties of commodity-linked equities (S&P Energy, Industrial Metals, and Agriculture) and the corresponding GSCI and DJ-AIG indices. Returns of S&P indexes were ranked in ascending order according to the DJ-AIG CI and GSCI indexes, respectively. Exhibit 5 shows plots of the indices in each of the groups. It is apparent from the plots that often direct investment in commodities can provide a positive return when commodity-linked stocks lose money. Clearly, direct commodity investment can provide downside portfolio protection in this sense.

Exhibit 5-a





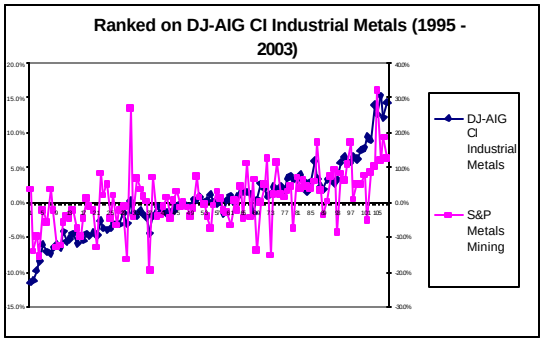
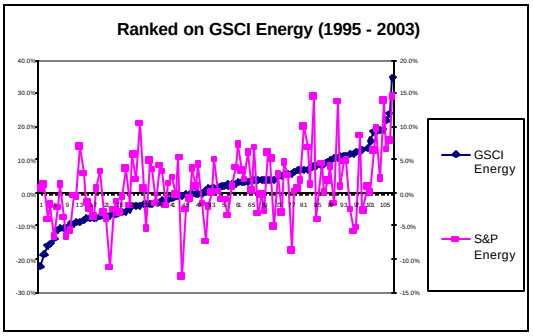
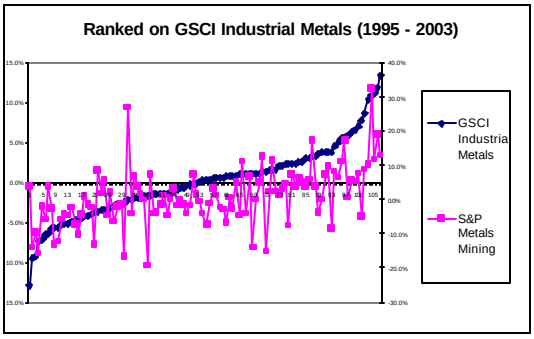
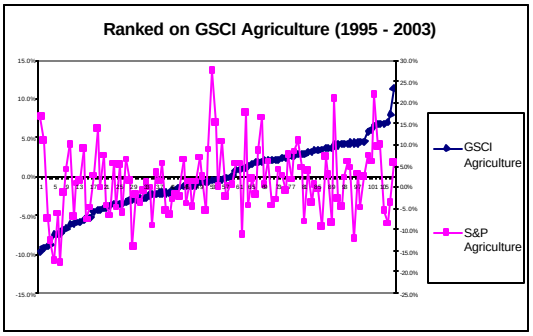


Exhibit 5-b







Roll Return

Finally, futures-based commodity investment can benefit from increased roll returns in periods of increased volatility of the underlying commodity and backwardation. For example, monthly roll returns on the GSCI Composite index were ranked against the intra-month volatility of the GSCI Composite spot price index. Exhibit 6-a shows a clear upward trend in average roll return with increasing intra-month spot volatility in the Composite index. Exhibit 6-b contains similar graphs for the six GSCI subindices. The described relationship between spot volatility and roll return is not observed for all commodity groups, but it is quite pronounced in the cases of Energy and Industrial Metals. This explains why the effect is observed in the Composite index as these groups dominate the index.

Mean roll returns and standard deviations for the Composite index and the six subindices in the least volatile and the most volatile 42 months (spot price volatility is meant here) are presented in the first and second columns of Exhibit 7, respectively. For each index, F-tests were run for equal variances of roll returns in the least volatile and the most volatile 42 months. Next, we tested for equality of the means of roll returns in each index/subindex pair, assuming either equal variance or unequal variance, depending on the results from the F-tests. The p-values of the variance and mean tests are presented in the last two columns of Exhibit 7.

As previously suggested by the graphs, mean roll returns for the Energy and Industrial Metals subindices, as well as the GSCI Composite Index, significantly increase and are positive with increased spot volatility. In contrast, mean roll return for the Livestock subindex decreases and becomes negative. The effect of spot price volatility on the mean roll return of the Agricultural,

Non-Energy, and Precious Metals subindices is insignificant. In general, the effect is more pronounced for non-perishable, storable commodities, whose convenience yield rises in periods of increased volatility due to demand and supply shocks.

Exhibit 6-a

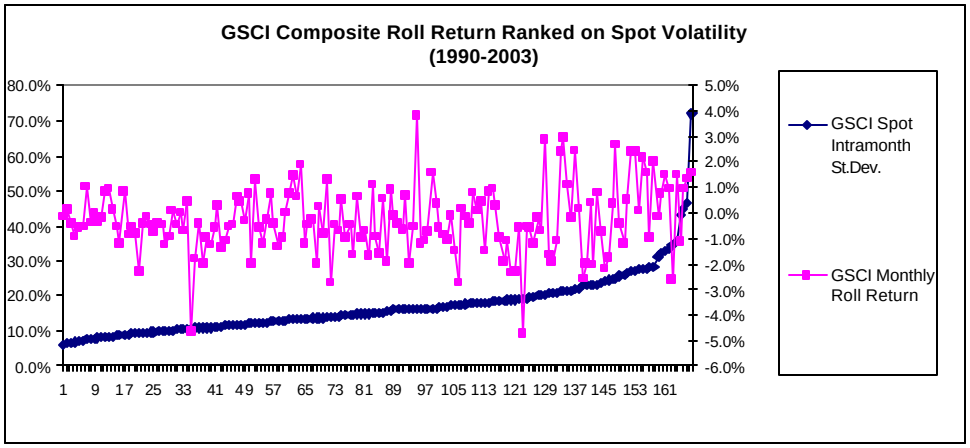
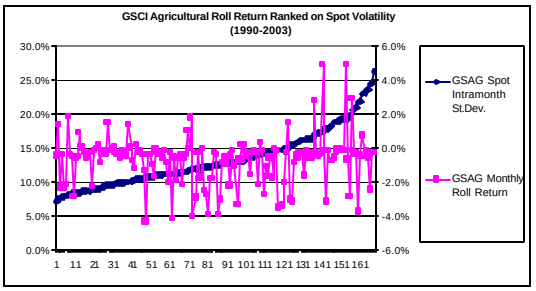
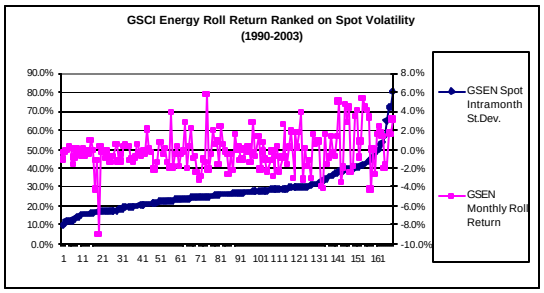
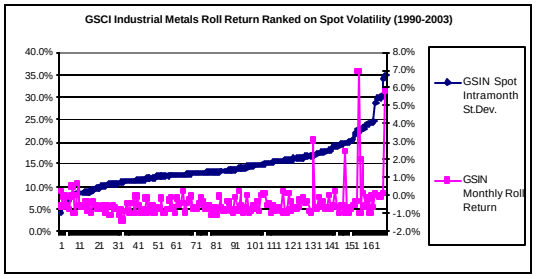
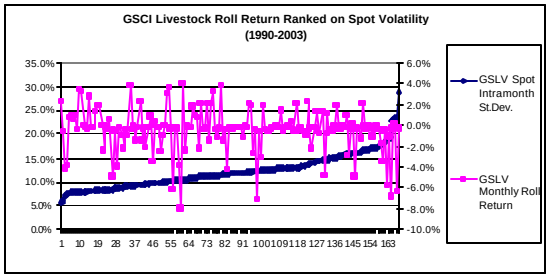


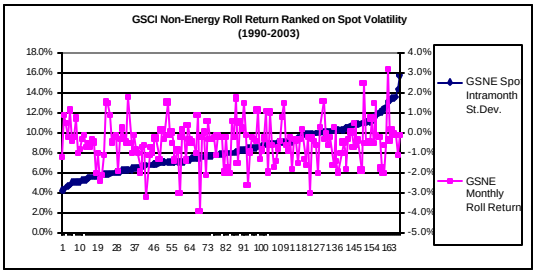
Exhibit 6-b











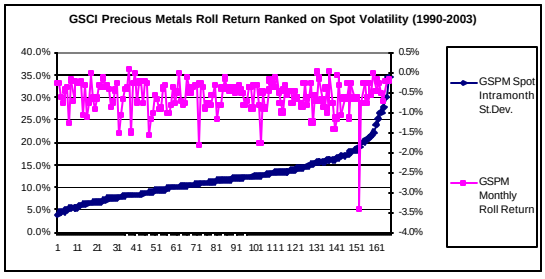


Exhibit 7

GSCI Roll Return Ranked on Monthly Spot Standard Deviation (1990 - 2003): Statistics and Tests

	Least Volatile 42 Months		Most Volatile 42 Months		H_0:Equal StDev	H_0:Equal Means
	Mean	St.Dev.	Mean	St.Dev.	p-value (two-tail)	p-value (two-tail)
GSCI Composite	-0.53%	0.97%	0.30%	1.64%	0.0010	0.0061
GSCI Agricultural	-0.37%	0.99%	-0.21%	1.64%	0.0016	0.5953
GSCI Energy	-0.77%	1.55%	0.65%	2.72%	0.0004	0.0044
GSCI Industrial Metals	-0.59%	0.43%	0.05%	1.67%	0.0000	0.0188
GSCI Livestock	-0.11%	1.97%	-0.90%	2.08%	0.7164	0.0751
GSCI Non-Energy	-0.45%	0.96%	-0.40%	1.11%	0.3648	0.8113
GSCI Precious Metals	-0.54%	0.38%	-0.62%	0.57%	0.0125	0.4533

Recent Research in Commodity Analysis

Jensen, Mercer, and Johnson [2002] examine the diversification benefits of adding managed and unmanaged commodity futures to a traditional portfolio that consists of U.S. equities, foreign equities, corporate bonds, and Treasury bills from 1973 through 1999. Consistent with previous evidence, they find that commodity futures substantially enhance portfolio performance for investors, and managed futures provide the greatest benefit. They show that the benefits of adding commodity futures (both managed and unmanaged) accrue almost exclusively when the Federal Reserve is following a restrictive monetary policy. The results suggest that metals and agricultural futures contracts offer the most diversification benefits for investors. Overall, the findings indicate that investors should gauge monetary conditions to determine the optimal allocation of commodity futures within a portfolio, and whether a short or a long position should be established in a particular type of contract.

Conclusions

In recent years, investable commodity indices and commodity linked assets have increased the number of available commodity-based products. This paper has shown that direct commodity investment can provide significant portfolio diversification benefits beyond those achievable from commodity-based stock and bond investment. These benefits stem from the unique exposure of commodities to markets forces such as unexpected inflation as well the potential of a positive roll return in futures-based commodity investment in periods of high spot price volatility. Adding a commodity component to a diversified portfolio of assets has been demonstrated to result in enhanced risk-adjusted performance. We believe that this research would place the use of investable commodity indices as a central part of the institutional investors' asset allocation decision.

The present research can be extended by studying the potential benefits of active trading in various commodity indices. Also, future studies might consider the impact of alternative asset allocation strategies under varying market conditions (e.g., business cycle) and the impact of investment into commodity linked-products or investable commodity indices under these economic conditions.

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